ISSUE 7

# DU MONT Instrument Journal

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INSTRUMENT DIVISION

DU MONT
Instrument
Journal

A PUBLICATION DEVOTED TO ELECTRONIC INSTRUMENTATION AND RELATED FIELDS. PROVIDING THE LATEST INFORMATION ON DEVELOPMENTS IN EQUIPMENT, APPLICATIONS AND TECHNIQUES. PERMISSION FOR REPRINTING ANY MATERIAL CONTAINED HEREIN MAY BE OBTAINED BY WRITING TO THE EDITOR AT THE ADDRESS BELOW.

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CONSULTING EDITOR -
NEIL UPTEGROVE

## On The Cover

The sound engineering department of Urania Records, Belleville, N. J., has recently incorporated a visual quality control technique as an integral part of its manufacturing process. Precise, high fidelity measurements of recordings and transcriptions are indicated by a Du Mont Type 401-A oscilloscope. The 401-A, as shown, is employed in monitoring master records from which pressings are obtained. It checks accuracy and quality of sound reproduction, and gives a visual representation of the quality of recordings in all frequency ranges. It also helps locate sources of distortion — whether in the system, amplifier, tone are, needle or cutting head of the recording mechanism. In addition, noise level, amplification, frequency of distortion and band width are indicated. High stability, inherent in the scope, is the prime requirement for this type of work.

## Binders Available

Vinyl plastic binders with capacity for at least a 6 years supply of *Du Mont Instrument Journals* are now available. See page 15.

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# OSCILLOSCOPE PHOTOGRAPHY BY POLAROID-LAND PROCESS

by H. P. Mansberg
Manager, Applications Engineering
Allen B. Du Mont Laboratories, Inc.

*A continuation of the feature started in Issue 6, in which the basic theory of Polaroid Land materials processing and characteristics of the various film emulsions presently available were discussed. Part II provides hints for photographing different kinds of traces, how writing rates are measured and the related effects of prefogging the film, and the reproduction of Polaroid Land oscillograms. The article offers practical "how to" information for the amateur as well as the professional photographer.*

**Part II**

## Photographing Stationary Patterns

The recording of stationary patterns with any oscilloscope camera (particularly one using Polaroid-Land film) is quite simple, and one can become expert at it after a few trials. Keep in mind that despite all of the considerations to be mentioned concerning exposure selection, these photographic materials have a wide exposure latitude. The fact that cathode-ray tube traces have a limited range of brightness values in any given trace reduces the need for as good gray scale rendition as in conventional photography.

Probably the most important requirement in selecting exposure time is that the shutter remain open for at least the duration of 1 sweep cycle. If this one precaution is not observed a blank space may occur in the recording. For example, if the sweep duration is 1/60 of a second, and a shutter speed of 1/100 of a second is used, the oscillogram may appear as in Figure 1. Even if the shutter open time is somewhat longer than the sweep duration, uneven exposure of the trace may result, as in Figure 2, depending on the spot brightness. It is generally preferred that the exposure time be a minimum of 5 or 10 times the sweep duration which results in a more uniform recording, as in Figure 3. Occasionally a deliberate overexposure is desired to obtain sufficient contrast at the high writing speed portions of the trace, even at the expense of considerable thickening of the low writing speed portions —as in Figure 4.

There are also circumstances when one may wish to use the shortest possible exposure time. For example, when a substantial amount of uncontrolled jitter of the trace occurs, the light-integrating effect of the film may result in a very blurred trace (using an otherwise normal exposure) as in Figure 5. It is obvious that a shorter exposure time would expose fewer cycles of jitter on the screen and provide a more legible record.

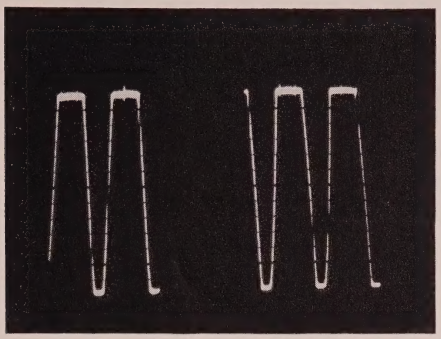


Figure 1. Exposure too short.

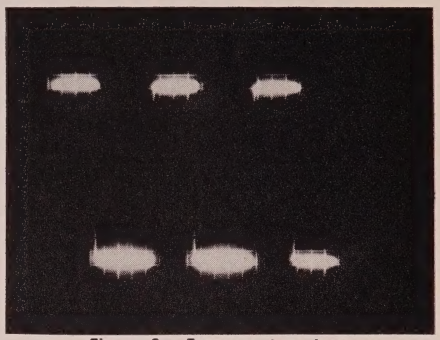


Figure 2. Exposure too short.

Figure 6, compared to Figure 5, illustrates the effect of reducing jitter blurring on the recording.

Aside from these considerations, the frequency of the signal or the repetition rate of a sweep does not effect the exposure for a given stationary number of cycles. With either recurrent or internally triggered sweeps, increasing the frequency of a signal decreases the exposure duration of each trace. It also increases the exposure repetition rate, if the sweep speed or frequency is readjusted to maintain the same number of cycles or pulses on the screen, and the total effect on the film remains the same. Thus, once experience has shown that a certain exposure is desirable for a given set of conditions, and the signal frequency is doubled without readjusting the sweep speed, the exposure time should also be doubled, or the aperture should be opened one stop. Similarly, doubling the signal amplitude also calls for doubling the exposure to obtain the identical density of recording.

## Photographing Intensity Modulation Markers

It was previously stated that the Panchromatic Polaroid films have a greater dynamic range, or gray scale, than Type 41 film. Occasionally a reduction of this range or an increase of contrast is desired; for example, when insufficient intensity modulation marker signal amplitudes are available—as in the oscillogram of Figure 7. Usually this effect is less troublesome in photographic recording than for visual work because the oscilloscope brightness control can be reduced and the exposure time increased to obtain improvement, as in Figure 8. In conventional photography the contrast of a negative can be increased by reducing exposure time and over-developing the film. This technique is also used to reduce the

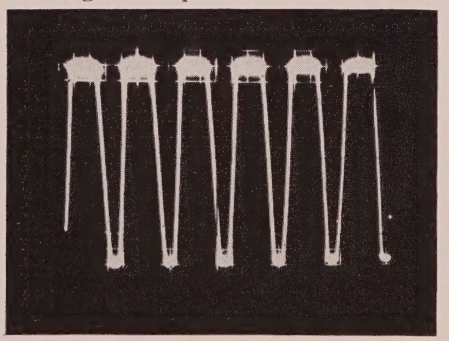


Figure 3. Correct exposure.

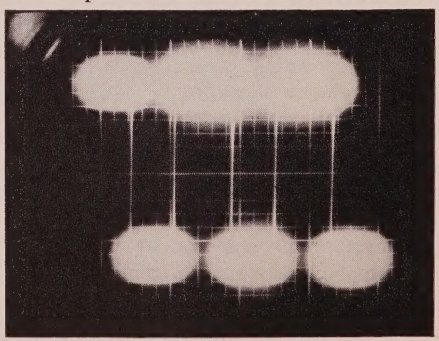


Figure 4. Deliberate overexposure.

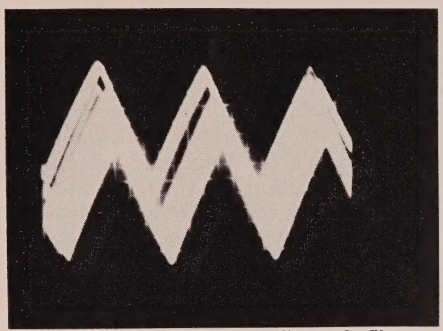


Figure 5. Light integrating effect of film on jittering trace.

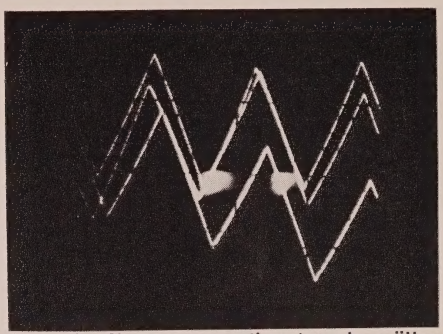


Figure 6. Short exposure time to reduce jitter effect.

effect of high frequency noise appearing on the trace. Although one does not have the same degree of control over contrast in the Polaroid-Land process, somewhat similar results can be obtained either by using Type 41 film, instead of the Panchromatic films, or by leaving the print in the camera back for a longer period of time than normally recommended. More drastic measures, such as cooling the film before use to 30°F and correspondingly increasing the developing time to 4 or 5 minutes, also results in reducing the gray scale range. It sometimes enhances the effects of intensity markers, although the blacks may not be as dense when processed at normal temperatures.

It is quite unnecessary, and perhaps futile, for the osciloscope manufacturer to provide a series of exposure tables to be used in recording stationary patterns. The conditions that occur in common oscilloscope use are so varied, even aside from the type of phenomena to be recorded, and include such factors as intensity control setting, choice of phosphor, use of filters, etc. Such that there can be no substitute for the experience of a few trial exposures. It can be suggested that (for a starting point) in such trial exposures using oscilloscopes with accelerating potentials of 3,000 volts or less, that an aperture of f/5.6 at an exposure of ½ to 1 second, with medium intensity control setting be used. For oscilloscopes with accelerating potentials greater than 3,000 volts one may start at f/11, with exposure of ½ second, at medium intensity control setting. In general, wide apertures are neither required nor desirable for recording stationary patterns.

The use of reduced camera lens apertures assure best focus for both the illuminated scale and the trace since they are not in the same object plane. Once the proper exposure for the trace is determined the illumi-

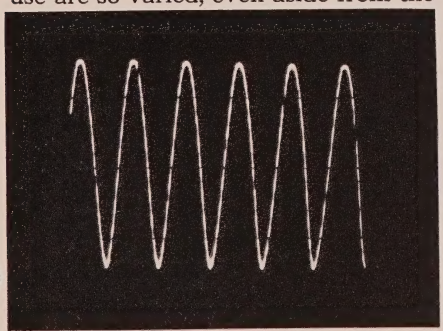


Figure 7. Insufficient intensity marker signal amplitude.

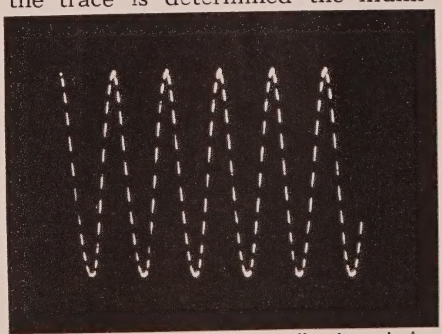


Figure 8. Improvement in recording by reducing scope brightness and increasing exposure time.

nated scale brightness of the oscilloscope should be adjusted so that a single exposure for the trace also provides the proper exposure for the scale.

## Photographing Transient Patterns

Despite all that has been published on photorecording techniques in the Du Mont *Oscillographer,* in the booklet *Techniques of Photo-Recording,* and in other journals, confusion seems to persist regarding such matters as maximum photographic writing speed. Let it be stated first that in recording repetitive transient patterns, the same considerations apply as for stationary patterns and the shutter must remain open long enough to record at least one complete sweep. For single transients, whether they can be controlled or initiated, or whether they are random, there is of course no choice but to leave the shutter open until the transient occurs. The term *maximum photographic writing rate* is meaningless when it is applied just to an oscilloscope, or just to a camera, or just to a film or to any single component of a recording system. It defines the maximum linear velocity of the cathode-ray tube spot in a single traverse that can be recorded *with useable density* for a particular cathode-ray oscilloscope, with a given camera and lens, a particular film emulsion and a specified processing technique.

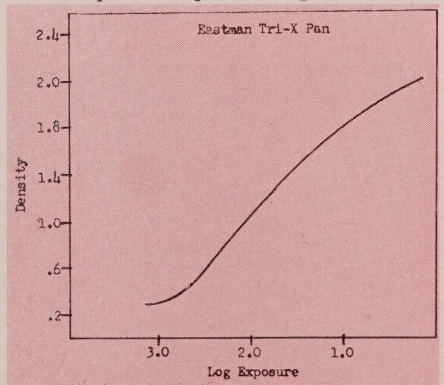



**Figure 9. Density vs. log exposure curve for high speed negative film.**

Even with all of these items exactly specified each is subject to variations which make it impossible for an oscilloscope, camera, or film manufacturer to guarantee a maximum photographic writing rate specification. For example, the cathode-ray tube manufacturer provides nominal brightness specifications under steady state conditions of beam current and accelerating potential, all of which may vary with the life of the tube and instrument and greatly affect the maximum writing rate. The film manufacturer quite logically only controls the emulsion speed to the extent required to meet the nominal ASA exposure ratings assigned to the film. This ASA exposure index is based on the exposure required to reach a contrast gradient, which is 0.3 of the average gradient on the density vs. log exposure curve of the film, when it is processed to give a desirable gray scale range for conventional continuous tone photography. Such a D vs. log E curve for a standard negative material is shown in Figure 9. In recording high speed single transients the result is governed by the slope at the toe or threshold of this curve, regardless of the gradient at the linear portion (important to conventional photography). Furthermore, the ASA ratings are based on both daylight and tungsten light, both of which are entirely different from the emission spectra of cathode-ray tube phosphors. In plotting a similar curve for Polaroid-Land materials, a reflection density vs. log exposure curve is used, as in Figure 10, and the threshold portion of importance for single transient photography is the shape of the shoulder at the upper left.

It is thus evident that considerable variation in the ASA exposure index may produce little effect on the threshold sensitivity. In some cases, when extremely short persistence phosphors are used, the discrepancy may be worsened by deviations from the so called Reciprocity Law —

which normally relates brightness to the reciprocal of exposure time. In other words, the effective exposure time for a spot moving at high velocity is extremely short; much shorter than the exposure time that can be obtained from mechanical shutters. It is well known that films deviate from the normally constant relationship of exposure time and image brightness when a wide range of exposure times is considered.

These factors are pointed out only for a general understanding of the problem of assigning maximum photographic writing rates. It still may be generally assumed that an emulsion having a higher ASA exposure index will provide a higher photographic writing rate — although not quantitatively related to the index number.

## Determining Photographic Writing Speeds

The purpose of this article is not to indulge in theoretical discussions on photography, but rather to provide the background for some practical information on how we measure photographic writing speeds. The best procedure is to photograph a single high frequency damped oscillation using an oscilloscope and cathode-ray tube known to be operating at nominal design specifications. To assure this, the accelerating potential, beam current and brightening gate amplitude are measured. Normally for single transient use the oscilloscope intensity control is set at the visual spot extinction point with no signal and, correspondingly, no sweep. It should be recognized of course that there can be considerable variation in this setting, depending upon the observer and the conditions of ambient illumination. However, in standard oscilloscope cameras the ambient illumination is fairly well controlled by a light shield.

At one time this measurement was made by monitoring the beam current and setting the initial intensity control position at the point of zero beam current. In modern oscilloscopes beam current limiting is controlled by circuit values, and adequate brightening gate amplitudes are provided to drive the beam to this limiting value. Furthermore, the oscilloscope user who determines his own maximum photographic writing rate limitations is certainly not expected to have equipment available, or even to have the desire to monitor these values.

An exposure of the triggered damped oscillation is made and the oscillogram is then processed in accordance with a procedure to obtain optimum results. The recording is observed with the peaks of the damped oscillation covered so that one can determine the particular cycle having a useable density. In the case of conventional negative films this *has not* been considered to be the point at which the trace is just visible, but rather the point at which the X-axis cross-over approximates a density of 0.1 above base fog. This criterion was selected because it is a trace density which can be printed by conventional techniques. For Polaroid-Land materials however, the oscillogram taken from the camera is usually the end product—so that the minimum trace density point has arbitrarily been used. The linear spot velocity is then calculated from the relation $\pi$ F A, where F is the frequency of the

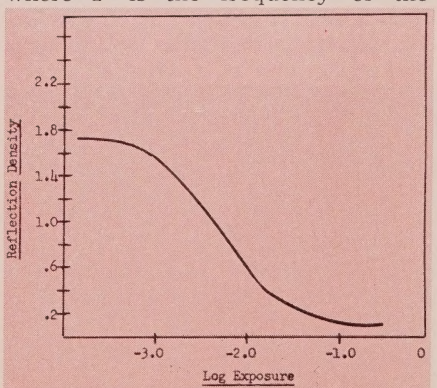



Figure 10. Typical reflection density vs. log exposure curve.

damped oscillation, and A is the peak-to-peak amplitude of the cycle just determined—referred to the cathode-ray tube screen. This velocity represents only the vertical component of spot velocity, but if 5 or 10 cycles are displayed the velocity component due to the sweep can usually be ignored.

Since minimum visible trace density is a subjective measurement dependent upon the method of viewing, it is even further obvious that a "maximum photographic writing rate" specification cannot be guaranteed, particularly for Polaroid-Land materials. It is sugested that the camera user views the Polaroid print or transparency by means of a very strong uniformly diffused white light. Often a very dim or invisible trace on a paper print can be seen with surprising clarity by transillumination; that is, holding the print in front of a bright light source.

## Presensitizing by Prefogging

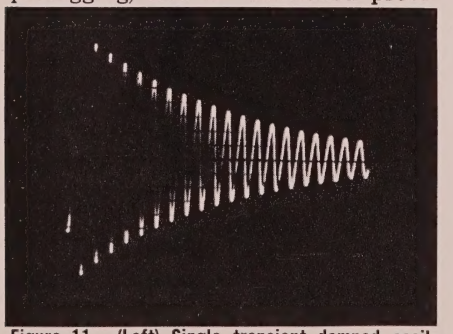
From a study of the D vs. log E curves, it would appear probable that if some means were used to transfer the location of the high speed transient exposure from the threshold portion to a portion having a greater slope, a greater densitometric effect of such an exposure could be obtained. A substantial improvement does, in fact, occur when Polaroid film is carefully prefogged to an optimum level. Type 41 film in particular responds remarkably well to such prefogging, and as mentioned previously, this procedure yields approximately a ten times increase in writing rate over normal use. An example of the effectiveness of prefogging the film to increase the maximum photographic writing rate is shown in Figure 11. The two damped oscillations are identical except for the presensitization of one exposure. The recommended procedure for prefogging the Polaroid-Land films is to place the camera barrel against a large sheet of flashed white opal glass which is 7 inches away from a 15 watt, 115 volt bulb. The exposures which give optimum results for the various Polaroid films are as follows:

1. Types 31 and 41 — 1/25 of a second at f/1.9 or 1 second at f/11
2. Types 32 and 42 — 1/50 of a second at f/4
3. Types 44 and 46 and 46L — 1/100 of a second at f/4

If a considerable amount of high speed transient photography is to be undertaken, it is recommended that a permanent arrangement be constructed—such as an illuminated box, using the 15 watt lamp and 7 inch distance from an opal glass as mentioned. Should other sources of illumination or lamp diffuser configurations be desired, the level of illumination should be set to 15 foot candles in order to use the exposures specified above.

## Table of Maximum Photographic Writing Rates

As a guide in determining which instruments and Polaroid films are



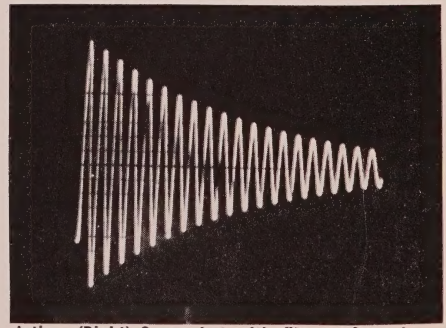


Figure 11. (Left) Single transient damped oscillation. (Right) Same, but with film prefogged.

## TABLE 2

### Maximum Photographic Writing Rates for Type 302 Camera, f/1.9 Lens

### Screen Type: P11, No Filter

| Oscilloscope Type No. | CRT | Accelerating Potential | Film Type 41 Normal cm/usec | Film Type 41 Prefogged cm/usec | Film Type 42 Normal cm/usec | Film Type 42 Prefogged cm/usec | Film Type 44 Normal cm/usec | Film Type 44 Prefogged cm/usec | Film Type 46-L Normal cm/usec | Film Type 46-L Prefogged cm/usec |
|---|---|---|---|---|---|---|---|---|---|---|
| 304-A | 5ADP | 3000 | 0.33 | 2.4 | 1 | 3 | 3.3 | 5.6 | 2.4 | 4 |
| 322-A | 5AFP | 3000 | 0.33 | 2.4 | 1 | 3 | 3.3 | 5.6 | 2.4 | 4 |
| 324 | 5AQP | 2800 Mono. | 0.29 | 2 | 0.88 | 2.7 | 1 | 5 | 2 | 4 |
| 329-A | 5ATP | 6000 Mono. | 1.5 | 15 | 5 | 15 | 15 | 60 | 15 | 45 |
| 411 | 5ARP | 2500 Mono. | 0.23 | 1.6 | 0.7 | 2.2 | 0.8 | 4 | 1.6 | 3 |
| 336-A | 5ATP | 6000 Mono. | 1.5 | 15 | 5 | 15 | 15 | 60 | 15 | 45 |
| 340 | 5AQP | 1500 Mono. | 0.06 | 0.4 | 0.18 | 0.55 | 0.2 | 1 | 0.4 | 0.75 |
| 350 | 5ADP | 3000 | 0.33 | 2.4 | 1 | 3 | 3.3 | 5.6 | 2.4 | 4 |
| 401-A | 5ADP | 3000 | 0.33 | 2.4 | 1 | 3 | 3.3 | 5.6 | 2.4 | 4 |
| 403 | 5AQP | 2500 Mono. | 0.23 | 1.6 | 0.7 | 2.2 | 0.8 | 4 | 1.6 | 3 |

Notes: 1) All values are approximate and subject to change.

2) For f/2.8 lens divide values by 2.2.

3) The P15 phosphor is also recommended for transient recording and will give writing rates approximately equal to the P11.

4) Blue filter reduces writing rate by approximate factor of 2 to 4.

required to record transients of known writing rate, Table 2 is provided for the Type 302 Oscilloscope Camera. Note that values are given for both normal and prefogged film conditions. It is particularly important to understand that these values were obtained under controlled laboratory conditions, using fresh film, and instruments known to be in good condition. These values are also subject to changes due to continuous improvement in film quality. As a practical example of the use of this table, let us assume that one wishes to record a rectangular wave transient having a maximum rise time of 1 microsecond, and that the amplitude on the cathode-ray tube screen is to be 5 centimeters. The maximum writing rate of the transient is then 5 centimeters per microsecond. Looking at the table we find that for a Type 302 Camera, a Type 401-A Oscilloscope can record this writing rate if Type 44 prefogged film is used.

## Choice of Phosphors

As for conventional photographic materials, the P11 phosphor screen remains one of the most efficient screens to use for photographic recording on Polaroid film. For the recording of recurrent phenomena and stationary patterns, all of the standard oscilloscope phosphor screens yield satisfactory results with Polaroid-Land materials. Recently it has been found that the P15 phosphor, which is commonly used in television Kinescope recording, yields maximum photographic writing speeds nearly equal to those obtained with the P11 phosphor. This phosphor has a much shorter persistence time than the P11 (which is of particular value in continuous moving film recording), and since its spectral characteristic is a maximum in the blue-green region it is rather more pleasing to the eye than the P11 screen. For certain applications therefore, when a considerable amount of both visual and photographic work is to be performed, the P15 phosphor may be preferable. A graph showing the relative spectral relationships of the P11 and P15 phosphors, must suitable for transient photography, is shown in Figure 12.

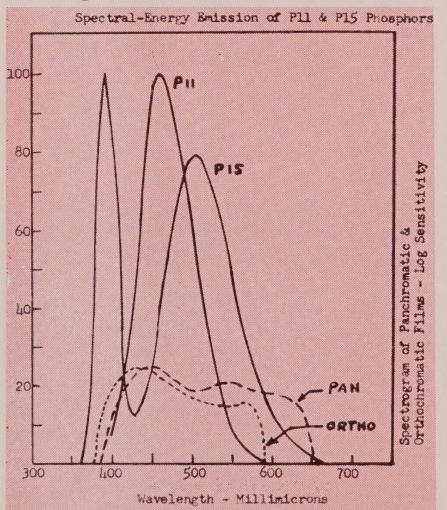



Figure 12. Spectral characteristics of phosphors and films.

It may be of interest also to observe, superimposed upon these spectral characteristics, the relative spectrograms of Orthochromatic and Panchromatic film emulsions. These curves are plotted to show relative spectral responses only, and no quantitative relationships between the ordinates of these curves should be implied. The spectral sensitivity curves for the films were plotted from wedge spectograms (made with artificial daylight). These wedge spectrograms show film sensitivity to a logarithmic ordinate scale.

## Use of Color Filters

Since an oscilloscope camera completely shields the cathode-ray tube from ambient light there is usually no advantage in using color filters during photo-recording, except where special effects are desired. In all cases the filters absorb a considerable amount of light, in addition to causing some slight degradation of quality due to surface inter-reflections. In

(*Continued on page* 15)

# A SIGNAL MARKER FOR USE WITH THE PHOTOGRAPHY OF OSCILLOSCOPE TRACES

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Harvard Medical School*

*A simple method for identifying specific exposed 35 mm. photographic film frames with any camera used to record oscilloscope traces is described. The system utilizes small lamps, on adjustable arms, in areas that will not effect the trace under study. Details on the set-up and expected results are given by the author.*

In neurophysiological and other studies where data is presented on a cathode-ray oscilloscope tube and recorded photographically, it is frequently necessary to indicate time signals, or a change in experimental conditions, and to accurately relate these signals to specific 35mm frames. Optimally, such signals should be easily applied, readily visible to the naked eye, apparent on a screen if the film is projected and offer no interference to the data being photographed.

Several techniques are available for recording such signals. Unexposed frames may be introduced by covering the camera lens. A numerical counter located beside the tube face may be photographed. Transients may be superimposed and the number of the superimpositions may be varied in accordance with a prefixed plan. Some commercially available cameras utilize a "Data Card Holder", which attaches to the viewing door aperture and reflects an image from an illuminated ground glass screen onto the emulsion through the film backing. Other methods employ a modification of the timebase circuit to give large amplitude deflections at will or automatically; still others add "Z" axis signals.

Disadvantages are associated with each of these methods; in particular those that interrupt the time sequence of frame exposures or modify the transient being studied. The most satisfactory signalling device is that incorporated into the housing of the Du Mont Oscilloscope Record Camera which exposes the side of the frame by an argon glow lamp.

For the oscilloscope user who does not possess a Du Mont Camera the problem can be very satisfactorily overcome by the use of an indicator similar to that previously described for use in the cinematography of reactions of experimental animals stimulated in the alert state (Hunter 1950). In its simplest form the indicator comprises a single small lamp mounted over the face of the oscilloscope tube by means of an adjustable wire arm (Fig. 1a). This lamp may be either an opthalmoscope lamp, a "grain of wheat lamp" or an argon glow lamp. By viewing the small lamp image on the film through the inspection gate of the camera, it is a simple matter to position the light so that it's image falls on the light sensitive emulsion on one side between sprocket holes, (Fig. 1c) if per-

*Work being carried out in New England Center Hospital, Army Contract #DA-49-007-MD-734.

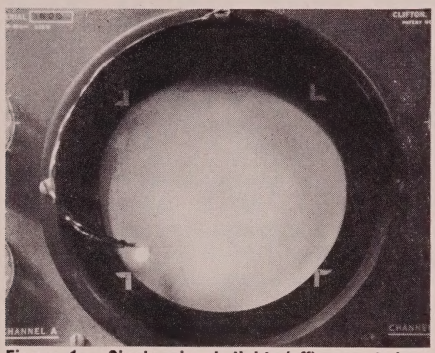


Figure 1a. Single signal light (off) mounted on adjustable wire arm close to face of oscilloscope. Markers on tube retention ring indicate photographic field.

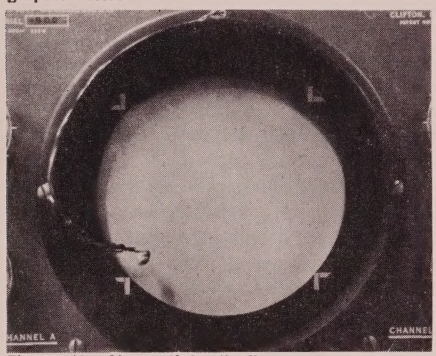


Figure 1b. Signal light "on".

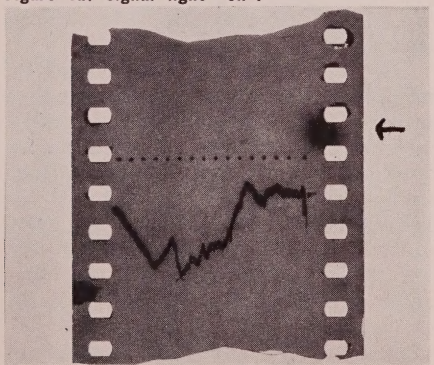


Figure 1c. Signal image (arrow) registered on 35 mm. frame (Eastman Linograph ortho). Mark on right edge of film is identification for selected frame (brushed on celluloid in colored solvent).

forated film is used, or well to the side of unperforated film. Alternatively, any site on the oscilloscope face not utilized for registering a transient response may be selected. Since the mounting area can usually be placed out of the photographic field, it has been found satisfactory to locate the lamp close to the oscilloscope tube face (i.e. in focus) as in Fig. 1a.

Because the tube face is not illuminated by transient responses in this area, the lamp itself casts no shadow and is invisible except when lit (Figs. 1b and 1c). In instances where a large area of the tube face is lit the lamp shadow may be rendered near invisible, if so desired, by placing the lamp itself closer to the camera lens and thus out of focus. The optimal intensity at which to operate the filament may be readily determined by trial exposures. The lamp may be operated by push button contacts or by switch.

In lengthy experiments, where many different signals must be recorded, more than one lamp may be used. In such instances one signal can register fixed time intervals in which case it may then be automatically activated by a cam or other cycle timer. If the shutter exposure is brief it may be necessary to light the lamp an instant before the transient appears in order to allow sufficient warm up time for the filament: Such a time sequence is readily provided by a relay.

**SUMMARY** A simple method for identifying specific exposed 35mm. photographic frames with any camera used for recording oscilloscope traces has been described. This method utilizes one or more small lamps supported by adjustable arms and mounted on the oscilloscope tube face. Such a lamp gives a mark which can be registered by push button or automatic control without interruption of film sequence, which is readily visible to the naked eye, and which does not interfere with the transients being studied or with a time base.

**References:**

Hunter, J., "A Stimulus Indicator For Use In Cinematography", **Journal of the Biological Photographic Association,** (May, 1950)

# Photographic Shutter and Flash Bulb Testing with Oscilloscopes

**From an article prepared by H. P. Mansberg**

*The following article is an adaption of a letter written by a former Manager of Applications Engineering for Du Mont. It was in answer to a manufacturer's query on the use of oscilloscopes in engineering and production testing of camera shutters and flash synchronization contacts. This easily consumed information will be beneficial to the photographic hobbiest as well as the camera and flash bulb manufacturer.*

Oscilloscopes are very suitable for engineering and production testing of camera shutters and flash synchronization contacts. When used with the proper auxiliary equipment, oscilloscope can aid manufacturers of photographic equipment, or hobbiests, in determining:

a. The speed and efficiency of camera shutters.
b. The synchronization of flash contacts.
c. The display of contact resistance and bounce.

All large camera manufacturing companies are now using techniques similar to those described below for laboratory and production testing of between-the-lens camera shutters, and have noted a definite assist in the maintaining of accuracy and quality control of camera shutters.

The basic method of testing between-the-lens camera shutters, by use of the oscilloscope, was described many years ago by the Du Mont Laboratories, and subsequently became the basis of the American Standards Association, Standard No. Z52.63-1946. A copy of this standard (or perhaps a more recent issue) may be obtained from the American Standards Association, 70 E. 45th Street, New York City, New York. This publication describes the method of calculating the efficiency of the shutter from the trapezoidal test pattern obtained by using the circuit arrangement shown in Figure 1. The phototube should be a vacuum type.

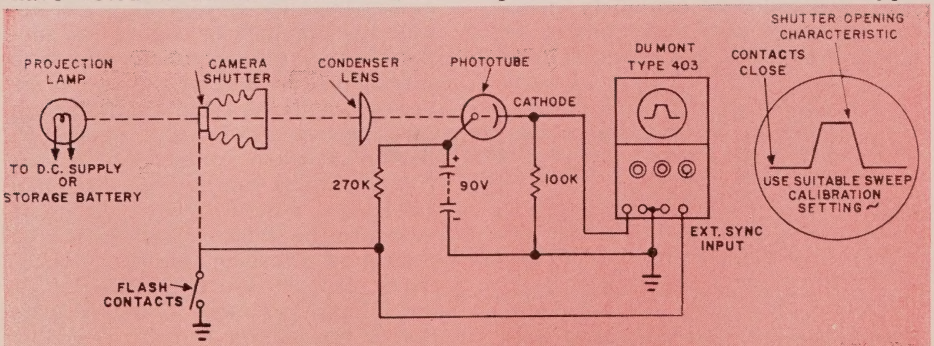



Figure 1. Method of measuring shutter efficiency, open time and synchronization.

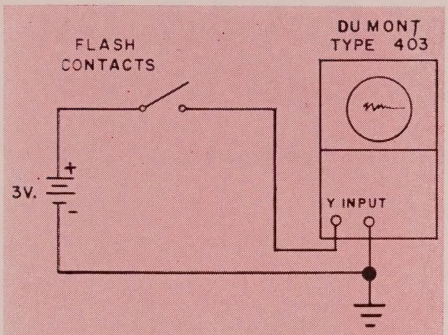



Figure 2. Observing contact bounce.

Some of the new photo-conductive diodes may also be used.

As shown in the sketch, the flash contact is connected to the "External Sync" input of the oscilloscope to start the sweep. By using an oscilloscope with a calibrated sweep the trapezoidal shutter waveform produced by the phototube will show how many milliseconds occur between the contact closing and the fully open time. In other words, for use with 23 millisecond flash bulbs, the flat top of the trace should occur 23 milliseconds after the start of the baselines.

For observing contact bounce and resistance, circuit configurations such as in Figures 2 and 3 can be used. They are self explanatory.

The Du Mont Type 403 with a P7 screen is recommended for these applications because of the convenience of its sweep calibration for standard shutter speeds, and because of its high sensitivity. The high amplifier sensitivity is extremely useful for detecting very low contact resistance and low signal levels from the phototube when used with small aperture lens-shutter combinations.

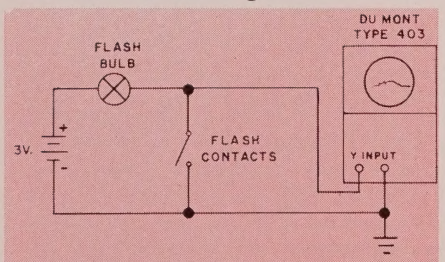



Figure 3. Observe voltage drop across switch contact resistance.

To display and measure flash bulb and shutter opening characteristics simultaneously, a dual-beam oscilloscope such as the Du Mont Type 411 would be very suitable. By means of another phototube directed at the flash lamp, and connected to the second Y-input available on the Type 411, both waveforms can be displayed simultaneously. In this manner, the most efficient flash synchronization can be obtained.

A dual-beam presentation is ideal for shutter and flash bulb testing because the light output characteristic can be most efficiently compared to the shutter characteristic. Flash bulb manufacturers find it convenient to sample test their product by using an intergrating sphere coated with magnesium oxide (or other very efficient white diffuse reflecting coating), and the phototube is inserted into a hole in the sphere with a neutral density filter or iris diaphragm. The phototube and oscilloscope are calibrated with a special tungsten lamp. The output of the flash bulb is then displayed on a cathode-ray tube calibrated in lumens. The total energy of the lamp must be controlled in terms of lumen-seconds so that both amplitude and time calibration are critical.

A more complex and perhaps preferable method of obtaining sweep synchronization is to use a solenoid to mechanically trip the shutter, while the closing of the solenoid switch trips the sweep. This will enable the operator to control the timing of the shutter characteristic, with respect to the start of the sweep, independent to the relationship of flash contact closing and shutter open time. To obtain flash contact timing, the contact timing can be observed separately as a Y-input signal or it can be added to the shutter characteristic by means of a resistor adding network. Most camera shutter contacts are synchronized to close 23 milliseconds before the shutter is fully open because the most popular lamps have

a 23 millisecond delay in the peak of flash light output. Cameras with focal plane shutters require FP type lamps with 5 millisecond delay, and electronic flash lamps are considered to have essentially zero delay.

For detailed information on methods of calibrating and testing camera shutters the following references are cited:

1. **Method of Determining Performance Characteristics of Between-the-Lens Shutters Used in Still Picture Cameras** — ASA Standard Z52.63-1946. (American Standards Association, 70 E. 45th Street, N. Y. C.)
2. **Method of Determining Performance Characteristics of Focal Plane Shutters Used in Still Cameras** — ASA Standard Z52.65-1946. (American Standard Association, 70 E. 45th Street, N. Y. C.)
3. Wallman, Henry. "A Cathode-ray Oscillograph Tester for Focal Plane Shutters". **Photographic Science and Technique**, Volume 1, Number 1, Series II (February, 1954).

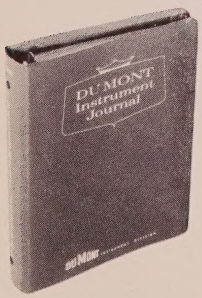
## Oscilloscope Photography by Polaroid Land Process

(*Continued from page* 10)

the rare case when extremely long exposures are to be made to await the ocurrence of a random transient, and the high speed Panchromatic film must be used, a blue filter provides an advantage with the P11 phosphor screen because it absorbs the red incandescence or cathode glow — which otherwise penetrates the P11 screen. This of course is never a problem with the higher voltage aluminized cathode-ray tube screens. In other cases one may wish to photograph the blue short persistence component of the cascaded P7 phosphor without producing an exposure from the yellow long persistence component. In such cases a blue filter is also helpful.

### Reproduction of Polaroid-Land Oscillograms

The availability of the new positive transparency materials, Type 46 and Type 46L, makes it extremly convenient to quickly obtain dizao-type prints for reports. The transparency may also be used for printing by any standard photographic process, but bear in mind that it is a positive transparency. A one step contact print or enlargement will produce a negative. This negative may be used directly, or of course it may again be printed to produce as many positives as desired. Another useful feature about this material is that the base negative also consists of a transparent plastic material. This negative may be removed from the camera immediately after the positive transparency is peeled off, and fixed in a conventional fixing bath to yield a fairly good quality negative. Exposure to air and light causes this negative to darken quickly unless it is fixed immediately. Negatives of the paper Polaroid-Land prints can of course also be made by the film manufacturer or any photocopying establishment.




## VINYL PLASTICS "D.I.J." BINDERS

If this picture were printed in solid red, we couldn't come closer to describing the exact appearance of the Du Mont Instrument Journal binders we have in stock. The vinyl plastic cover assures years of wear. The 1¼-inch, three ring holder, with "push" lifters, also gives the backbone a sturdy, non-collapsible support. We experimented with average thickness issues of the Du Mont Instrument Journal, and found that the binder will hold at least a six year's supply comfortably.

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# WHAT MAKES A SCOPE GOOD?

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**DEPENDABILITY**

The good scope must be designed and built to provide day-in, day-out, "up-to-specs" performance. It is capable of service longevity in keeping with the monetary investment.

**VERSATILITY**

In addition to its prime function of providing consistently accurate displays within its specified ranges, a good scope has inherent versatility in its selection and method of sweep modes, synchronization and acceptable types of input.

**EASE OF OPERATION**

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